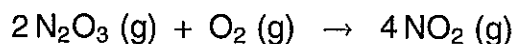


Obtain the rate expression corresponding to this mechanism. (E10)

SELF-TEST

A. Multiple Choice:

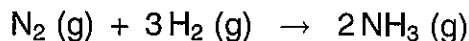
1. Consider the reaction



Which of the following statements is correct?

- a. It is first order in N_2O_3 .
- b. It is second order in N_2O_3 .
- c. It is third order overall.
- d. It is both b and c.
- e. The order of the reaction cannot be predicted without more information.

2. For the reaction



a catalyst is required. Addition of the catalyst

- a. lowers the activation energy.
- b. produces more H_2 (g) for the reaction.
- c. changes ΔH for the reaction.
- d. does none of the above.

3. Which of the following steps appearing in a mechanism would be third order overall?

- a. $\text{SO}_2\text{Cl}_2 \text{ (g)} \rightarrow \text{SO}_2 \text{ (g)} + \text{Cl}_2 \text{ (g)}$
- b. $2 \text{NO (g)} + \text{O}_2 \text{ (g)} \rightarrow 2 \text{NO}_2 \text{ (g)}$
- c. $2 \text{N}_2\text{O (g)} \rightarrow 2 \text{N}_2 \text{ (g)} + \text{O}_2 \text{ (g)}$
- d. $2 \text{HI (g)} \rightarrow \text{H}_2 \text{ (g)} + \text{I}_2 \text{ (g)}$

1 of the following statements is true for a zero order reaction?

- a rate constant equals zero.
- a activation energy equals zero.
- a rate is independent of concentration.
- a half-life is equal to $0.693/k$.
- none of those.

ion rates increase with temperature. How many of the statements below describe the phenomenon?

- Molecular velocities increase.
- The average kinetic energy of the molecules increases.
- The fraction of high energy molecules increases.
- Collisions occur more frequently at high temperatures.

b. 1

c. 2

d. 3

e. 4

st order reaction with time measured in seconds (s) and concentration measured in mol/L, the rate constant k can have units of

b. s^{-1} c. $s \cdot \text{mol/L}$

l/L·s

e. none of these

of reactants reacts in two different ways to give a desired product (D) and an undesirable product (U). At 100°C , D and U are formed at the same rate. At 120°C , D is formed faster than U. Which one of the following statements is true?

- a reaction forming U has the larger activation energy.
- a reaction forming D has the larger activation energy.
- both reactions have the same activation energy.
- enough information is given.

etermine the rate constant of a suspected second order reaction, you would plot $\ln[X]$ is the concentration of the reactant and t is time)

a. $\ln[X]$ vs. t b. $[X]$ vs. t c. $\ln[X]$ vs. t d. $1/[X]$ vs. $1/t$ e. $1/[X]$ vs. t

value of the half-life of a first order reaction depends on

- (1) the initial concentration of the reactant.
- (2) the value of the rate constant.
- (3) the temperature of the reaction.
- (4) the ΔH of the reaction.
- (5) the final concentration of the reactant.

a. (2)

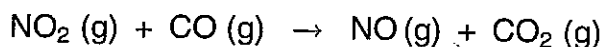
b. (2),(3)

c. (3),(4)

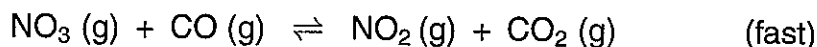
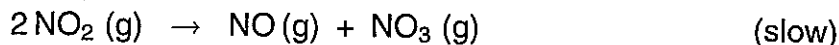
d. (4),(5)

e. (1),(3),(5)

10. Consider the following overall reaction.



A proposed mechanism for this overall reaction is



If the proposed mechanism is valid, the rate expression for the overall reaction could be

- a. $k[\text{NO}_3][\text{NO}]$ b. $k[\text{NO}_2]^2$ c. $k[\text{NO}_2]$ d. $k[\text{NO}_2][\text{CO}]$

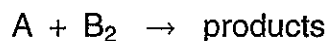
B. True or False:

- _____ 1. In a zero order reaction, the reactant's concentration remains the same throughout the reaction.
- _____ 2. The unit for the rate of any reaction, regardless of order, is always concentration per unit time.
- _____ 3. The overall order of a reaction can be determined by adding the coefficients of the reactants in the balanced equation.
- _____ 4. The presence of a catalyst will not change the value of the rate constant, k , for the reaction, provided that the temperature is kept constant.
- _____ 5. For the reaction
$$\text{A} \rightarrow 2\text{B}$$
the rate at which A is used up is half the rate at which B is produced.
- _____ 6. The order of a reaction with respect to a reactant can be 0.50.
- _____ 7. Consider two different reactions, 1 and 2, both done at the same temperature. If $E_{a1} > E_{a2}$, then $k_2 > k_1$.
- _____ 8. Any time a collision between two reactant molecules occurs, a reaction takes place.
- _____ 9. When two molecular compounds react, the bonds broken by the collision between the molecules are covalent bonds.
- _____ 10. The presence of a catalyst in a reaction changes both E_a and ΔH for that reaction.

- _____ 11. The presence of a catalyst speeds up a reaction.
- _____ 12. A catalyst does not affect the path a reaction takes.
- _____ 13. A catalyst shifts the equilibrium of a reaction.
- _____ 14. A catalyst lowers the activation energy of a given reaction.
- _____ 15. A catalyst gets consumed during a reaction.

C. Problems:

Consider the reaction



The following experimental data were obtained:

Expt.	[A] (M)	[B] (M)	Rate (mol/L·s)
1	0.100	0.100	8.0×10^{-3}
2	0.500	0.100	2.0×10^{-1}
3	0.100	0.500	4.0×10^{-2}

1. What is the order of the reaction with respect to each reactant?

2. What is the rate constant of the reaction?

3. The reaction is done at 22.0°C . It is determined that the activation energy of the reaction is 115 kJ/mol . What is the rate constant of the reaction at 27.0°C ?

Consider the first order decomposition of A. The rate constant is $1.7 \times 10^{-2}\text{ min}^{-1}$.

4. Calculate the rate of the reaction when the initial concentration of A is 0.200 M .

5. What percent of A will be used in one hour?

6. What is the half-life of the reaction?

ANSWERS**Exercises:**

- 1) $1/2$ (E2) $\text{rate} = k[X]^{1/2}$ (E3) $0.95 \text{ mol}^{1/2}/\text{L}^{1/2} \cdot \text{s}$
 2) 0.90 M (E5) $\text{rate} = k[A][B]^2$ (E6) $\text{SO}_2\text{Cl}_2(\text{g}) \rightarrow \text{SO}_2(\text{g}) + \text{Cl}_2(\text{g})$
 3) 2.8 hr (E8) 0.16 M (E9) 22°C
 4) $\text{rate} = k[\text{NO}]^2[\text{Cl}_2]$

Self-Test**Multiple Choice:**

- | | | | | |
|------|------|------|------|-------|
| 1. e | 2. a | 3. b | 4. c | 5. e |
| 6. b | 7. a | 8. e | 9. b | 10. b |

True or False:

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. F | 2. T | 3. F | 4. F | 5. T |
| 6. T | 7. T | 8. F | 9. T | 10. F |
| 11. T | 12. F | 13. F | 14. T | 15. F |

Problems:

- | | |
|---|--|
| 1. second order in A, first order in B | 2. $8.0 \text{ L}^2/\text{mol}^2 \cdot \text{s}$ |
| 3. $18 \text{ L}^2/\text{mol}^2 \cdot \text{s}$ | 4. $3.4 \times 10^{-3} \text{ mol/L} \cdot \text{min}$ |
| 5. 64 % | 6. 41 min |